

## CLAIMS

1. A method for use in a receiver, the method comprising:
  - receiving a multi-level modulation signal having at least two signal layers; and
  - recovering a carrier from the received multi-level modulation signal as a function of soft decisions with respect to a first layer of the at least two layers.
2. The method of claim 1, wherein the multi-level modulation signal is a layered modulation signal.
3. The method of claim 2, wherein the recovering step further comprises:
  - demodulating the first layer of the received layered modulation signal to provide a demodulated first layer signal representing a stream of signal points;
  - soft decoding the demodulated first layer signal to provide a decoded first layer signal;
  - generating a remapped first layer signal from the decoded first layer signal, the remapped first layer signal representing a stream of symbols;
  - recovering a carrier from the received layered modulation signal using the remapped first layer signal; and
  - processing the received layered modulation signal with the recovered carrier to extract therefrom a second layer of the at least two layers of the received layered modulation signal.
4. The method of claim 3, wherein the generating step includes the steps of:
  - reencoding the decoded first layer signal to provide a reencoded first layer signal; and
  - remapping the reencoded first layer signal to provide the remapped first layer signal.
5. The method of claim 3, wherein the generating step remaps the decoded first layer signal to provide the remapped first layer signal.
6. The method of claim 3, wherein the recovering step includes the step of filtering the received layered modulation signal for removing intersymbol interference associated with the first layer signal.
7. The method of claim 3, wherein the processing step includes the steps of :

derotating the received layered modulation signal with the recovered carrier to provide a derotated version of the received layered modulation signal;

filtering the remapped first layer signal; and

subtracting the filtered remapped first layer signal from the derotated version of the received layered modulation signal to extract therefrom the second layer.

8. The method of claim 3, wherein the processing step includes the steps of:

rerotating the remapped first layer signal using the recovered carrier to provide a rerotated remapped first layer signal;

filtering the rerotated remapped first layer signal; and

subtracting the filtered rerotated remapped first layer signal from the received layered modulation signal to extract therefrom the second layer.

9. The method of claim 1, wherein the first layer signal is an upper layer signal and the second layer signal is a lower layer signal.

10. A method for use in a receiver, the method comprising:

demodulating and soft decoding a first layer signal component of a received multi-level modulation signal to provide a decoded first layer signal;

remapping the decoded first layer signal to provide a remapped first layer signal;

generating a soft-decision based carrier from the received multi-level modulation signal as a function of the remapped first layer signal; and

demodulating a second layer signal component of the received multi-level modulation signal using the soft-decision based carrier.

11. The method of claim 10, wherein the received multi-level modulation signal is a received layered modulation signal.

12. The method of claim 10, wherein the first layer signal component is an upper layer component and the second layer signal component is a lower layer component.

13. The method of claim 10, wherein the demodulating step includes the step of derotating the received multi-level modulation signal using the soft-decision based carrier.

14. The method of claim 10, wherein the generating step includes the step of filtering the received multi-level modulation signal for removing intersymbol interference associated with the first layer signal component.

15. The method of claim 10, wherein the remapping step includes the step of first reencoding the decoded first layer signal.

16. A method for use in a receiver, the method comprising:  
receiving a multi-level modulation signal;  
performing a carrier recovery process driven by soft decisions with respect to a first layer signal component of the received multi-level modulation signal to provide a recovered carrier; and  
demodulating and decoding a second layer signal component of the received multi-level modulation signal as a function of the recovered carrier.

17. The method of claim 16, wherein the first layer signal component is an upper layer signal component and the second layer signal component is a lower layer signal component.

18. The method of claim 16, wherein the multi-level modulation signal is a layered modulation signal.

19. Apparatus for use in a receiver, the apparatus comprising:  
a demodulator for demodulating a received signal to provide a demodulated signal;  
a soft decision decoder for decoding the demodulated signal to provide a decoded signal;  
a remapper for remapping the decoded signal to provide an remapped; and  
a carrier recovery element responsive to the remapped signal and the received signal to provide a soft-decision based carrier.

20. The apparatus of claim 19, wherein the carrier recovery element includes a phase error estimator responsive to the received signal and the remapped signal for estimating phase errors therebetween.

21. The apparatus of claim 19, wherein the apparatus is an integrated circuit.

22. The apparatus of claim 19, wherein the remapper includes an encoder for reencoding the decoded signal.

23. The apparatus of claim 19, wherein the received signal is a multi-level modulation signal.

24. The apparatus of claim 23, wherein the multi-level modulation signal is a layered modulation signal.

25. Apparatus for use in a receiver, the apparatus comprising:

a first demodulator for demodulating a received signal to provide a demodulated first layer signal;

a first decoder for decoding the demodulated first layer signal to provide a decoded first layer signal;

a remapper for remapping the decoded first layer signal to provide a remapped first layer signal; and

a carrier recovery element responsive to the remapped first layer signal and the received signal to provide a soft-decision based carrier.

26. The apparatus of claim 25, further comprising a derotator for derotating the received signal with the soft-decision based carrier to provide a derotated version of the received signal.

27. The apparatus of claim 26, further comprising an extractor responsive to the derotated received signal and remapped first layer signal for providing a second layer signal component of the received signal.

28. The apparatus of claim 27, wherein the extractor comprises a filter for filtering the remapped first layer signal and a subtraction element for subtracting the filtered remapped first layer signal from the derotated version of the received signal.

29. The apparatus of claim 27, further comprising a second demodulator for demodulating the second layer signal component of the received signal to provide a demodulated second layer signal.

30. The apparatus of claim 29, further comprising a second decoder for decoding the demodulated second layer signal to provide a decoded second layer signal.

31. The apparatus of claim 25, wherein the apparatus is an integrated circuit.

32. The apparatus of claim 25, wherein the carrier recovery element includes a phase error estimator responsive to the received signal and the remapped first layer signal for estimating phase errors therebetween.

33. The apparatus of claim 25, wherein the remapper includes an encoder for reencoding the decoded first layer signal.

34. The apparatus of claim 25, wherein the received signal is a layered modulation signal.

35. The apparatus of claim 25, wherein the carrier recovery element further includes a filter for removing intersymbol interference associated with the first layer signal component from the received signal.

## AMENDED CLAIMS

[Received by the International Bureau on 17 December 2004 (17.12.2004):  
original claims 1-35 replaced by amended claims 1-27]

1. A method for use in a receiver, the method comprising:  
receiving a multi-level modulation signal having at least two signal layers;  
recovering a carrier from the received multi-level modulation signal as a function of soft decisions with respect to a first layer of the at least two layers; and  
using the recovered carrier to recover a different layer of the at least two signal layers.
2. The method of claim 1, wherein the multi-level modulation signal is a layered modulation signal.
3. The method of claim 2, wherein the recovering step further comprises:  
demodulating the first layer of the received layered modulation signal to provide a demodulated first layer signal representing a stream of signal points;  
soft decoding the demodulated first layer signal to provide a decoded first layer signal;  
generating a remapped first layer signal from the decoded first layer signal, the remapped first layer signal representing a stream of symbols;  
recovering a carrier from the received layered modulation signal using the remapped first layer signal;  
and wherein the using step includes the step of  
processing the received layered modulation signal with the recovered carrier to extract therefrom a second layer of the at least two layers of the received layered modulation signal.
4. The method of claim 3, wherein the generating step includes the steps of:  
reencoding the decoded first layer signal to provide a reencoded first layer signal; and  
remapping the reencoded first layer signal to provide the remapped first layer signal.
5. The method of claim 3, wherein the generating step remaps the decoded first layer signal to provide the remapped first layer signal.

6. The method of claim 3, wherein the processing step includes the step of filtering the received layered modulation signal for removing intersymbol interference associated with the first layer signal.

7. The method of claim 3, wherein the processing step includes the steps of:  
derotating the received layered modulation signal with the recovered carrier to provide a derotated version of the received layered modulation signal;  
filtering the remapped first layer signal; and  
subtracting the filtered remapped first layer signal from the derotated version of the received layered modulation signal to extract therefrom the second layer.

8. The method of claim 3, wherein the processing step includes the steps of:  
rerotating the remapped first layer signal using the recovered carrier to provide a rerotated remapped first layer signal;  
filtering the rerotated remapped first layer signal; and  
subtracting the filtered rerotated remapped first layer signal from the received layered modulation signal to extract therefrom the second layer.

9. The method of claim 1, wherein the first layer signal is an upper layer signal and the different layer is a lower layer signal.

10. A method for use in a receiver, the method comprising:  
demodulating and soft decoding a first layer signal component of a received multi-level modulation signal to provide a decoded first layer signal;  
remapping the decoded first layer signal to provide a remapped first layer signal;  
generating a soft-decision based carrier from the received multi-level modulation signal as a function of the remapped first layer signal; and  
demodulating a second layer signal component of the received multi-level modulation signal using the soft-decision based carrier.

11. The method of claim 10, wherein the received multi-level modulation signal is a received layered modulation signal.

12. The method of claim 10, wherein the first layer signal component is an upper layer component and the second layer signal component is a lower layer component.

13. The method of claim 10, wherein the demodulating step includes the step of derotating the received multi-level modulation signal using the soft-decision based carrier.

14. The method of claim 10, wherein the generating step includes the step of filtering the received multi-level modulation signal for removing intersymbol interference associated with the first layer signal component.

15. The method of claim 10, wherein the remapping step includes the step of first reencoding the decoded first layer signal.

16. A method for use in a receiver, the method comprising:

receiving a multi-level modulation signal;

performing a carrier recovery process driven by soft decisions with respect to a first layer signal component of the received multi-level modulation signal to provide a recovered carrier; and

demodulating and decoding a second layer signal component of the received multi-level modulation signal as a function of the recovered carrier.

17. The method of claim 16, wherein the first layer signal component is an upper layer signal component and the second layer signal component is a lower layer signal component.

18. The method of claim 16, wherein the multi-level modulation signal is a layered modulation signal.

19. Apparatus for use in a receiver, the apparatus comprising:

a first demodulator for demodulating a received signal to provide a demodulated first layer signal;

a first decoder for decoding the demodulated first layer signal to provide a decoded first layer signal;

a remapper for remapping the decoded first layer signal to provide a remapped first layer signal; and

a carrier recovery element responsive to the remapped first layer signal and the received signal to provide a soft-decision based carrier;

a derotator for derotating the received signal with the soft-decision based carrier to provide a derotated version of the received signal; and

an extractor responsive to the derotated received signal and remapped first layer signal for providing a second layer signal component of the received signal.

20. The apparatus of claim 19, wherein the extractor comprises a filter for filtering the remapped first layer signal and a subtraction element for subtracting the filtered remapped first layer signal from the derotated version of the received signal.

21. The apparatus of claim 19, further comprising a second demodulator for demodulating the second layer signal component of the received signal to provide a demodulated second layer signal.

22. The apparatus of claim 21, further comprising a second decoder for decoding the demodulated second layer signal to provide a decoded second layer signal.

23. The apparatus of claim 19, wherein the apparatus is an integrated circuit.

24. The apparatus of claim 19, wherein the carrier recovery element includes a phase error estimator responsive to the received signal and the remapped first layer signal for estimating phase errors therebetween.

25. The apparatus of claim 19, wherein the remapper includes an encoder for reencoding the decoded first layer signal.

26. The apparatus of claim 19, wherein the received signal is a layered modulation signal.

27. The apparatus of claim 19, wherein the carrier recovery element further includes a filter for removing intersymbol interference associated with the first layer signal component from the received signal.